

## The Core: What it is and what it is not

Orr, Rob Marc

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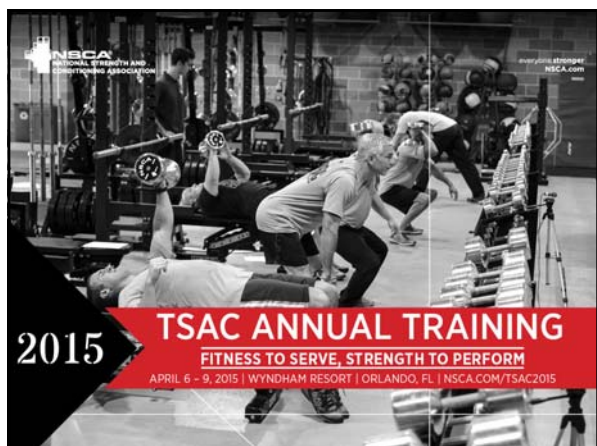
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## The Core: What it is and what it is not.

Dr Rob Orr (PhD, Mphity, BFET, ADFPTI, TSAC-F)

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## BLUF

The concept up front:

- When training the core are you treating the victim?
- All tissues have a yield point?
- What causes overtraining?

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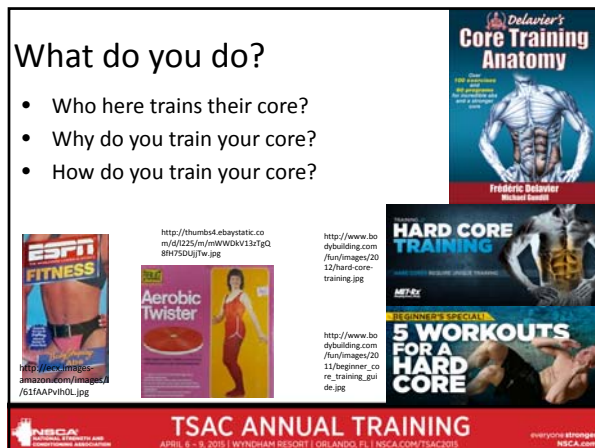
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## What do you do?

- Who here trains their core?
- Why do you train your core?
- How do you train your core?



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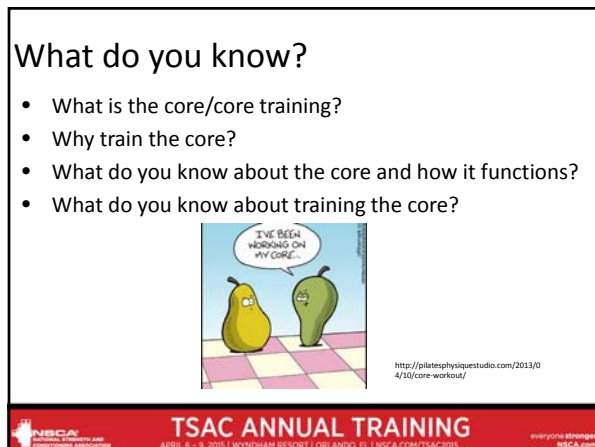
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## What do you know?

- What is the core/core training?
- Why train the core?
- What do you know about the core and how it functions?
- What do you know about training the core?



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## What is the core and core training?



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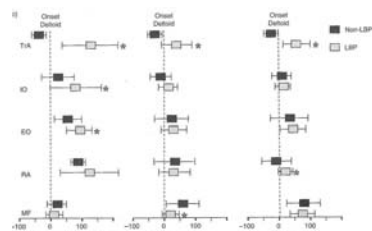
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## Why train the core?

- To increase spinal stability
  - Have they been diagnosed with an segmental instability?

## Why train the core?

- Previous Hx of Back Pain?
  - Delayed TrA



## Why train the core?

- Previous Hx of Neck Pain?
  - Pts with WADs found to have postural control system impairments (Treleaven, et al. 2003; Heikkila & Astrom, 1996)
  - Includes altered kinaesthetic sense with increased cervical JPE (Treleaven, et al. 2003; Heikkila & Astrom, 1996)



## Why train the core?

- Make the core stronger?
  - TrA thickness does not change above 20-30% MVC (Himes et al., 2012).

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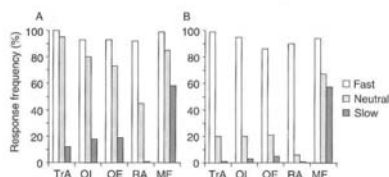
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## Why train the core?

- Make the core stronger?
  - Research suggests that the problem is not one of strength or endurance but of motor control (Jull, et al., 1999)



Jull, G., Hodges, P., Hides, J., & Panjabi, M. M. (1999). *Therapeutic exercise for spinal segmental stabilization in low back pain: scientific basis and clinical approach* (pp. 61-76). Edinburgh: Churchill Livingstone., Fig 5.5

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## What do you know about the core?

- Common Terms – Is there a difference
  - Rigidity vs Stability vs Stiffness
- 4 Roles of muscles in movement
  - Which roles are they training for?
  - Does this make a difference?

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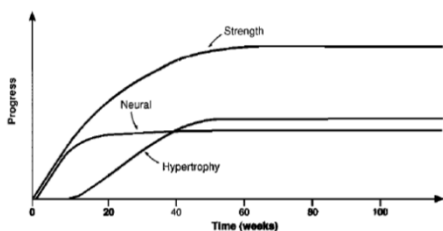
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## What do you know about the core?

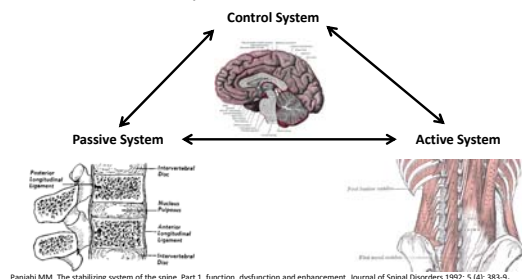


Wilmore, J.H., Costill, D.L. & Kenney, W.L., (2008). Physiology of Sport and Exercise, 4th Edition Champaign, IL: Human Kinetics. Fig 28



## What do you know about the core?

- So what is stability and how is it maintained?

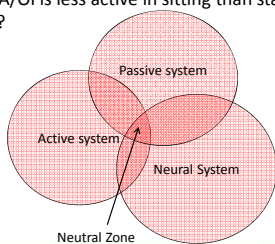


Panjabi MM. The stabilizing system of the spine. Part 1, function, dysfunction and enhancement. Journal of Spinal Disorders 1992; 5 (4): 383-9.




## What do you know about the core?

- So what is stability and how is it maintained?
  - Optimal alignment at rest = minimal load and effort
  - The TrA/OI is less active in sitting than standing – more stable?




# The Control System


- Do you think that they are thinking ‘Gently draw in my abdominals?’



[http://photothe.boston.com/contentimage\\_gmphotohttp://photosunlighten\\_06\\_30\\_10d07\\_2605055.jpg](http://photothe.boston.com/contentimage_gmphotohttp://photosunlighten_06_30_10d07_2605055.jpg)



<http://thesuncoast.news.com.au/images/2011/02/11/2817286417 Occupy-Malbourne.jpg>



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# The Control System

- Do you think the core is 'stiff'?

<http://www4.pictures.zimbio.com/gf/Time+Cailli+A+KCa+KCa+Cap+Semi+Final+Ube+kusan+38.0fBhznEj.jpg>



<https://hyanmythtradition.files.wordpress.com/2011/05/mic-hael-jordan.jpg>



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# The Control System

- Do you think the core is 'stiff'?

<http://www.history.army.mil/brochures/afghanistan/images/40.jpg>  
[https://timemilitary.files.wordpress.com/2012/10/hires\\_120929-a-0064-701c.jpg?w=480](https://timemilitary.files.wordpress.com/2012/10/hires_120929-a-0064-701c.jpg?w=480)  
[http://i.telegraph.co.uk/multimedia/archive/01376/police-bators\\_1376843.jpg](http://i.telegraph.co.uk/multimedia/archive/01376/police-bators_1376843.jpg)  
<http://nav-cdn.com/sites/default/files/imgcache/superphoto/editorial/img-agen/savannah/mcDControlled/cms/2010/04/29/k28359165.jpg>  
[http://www.firefight.companies.com/MFC/public/news\\_img/10066/54478/113805\\_orig.jpg](http://www.firefight.companies.com/MFC/public/news_img/10066/54478/113805_orig.jpg)

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## The Control System

- Active System (Abdominal Muscle Recruitment)
  - **ALL** of the abdominal muscles have been reported to be active in advance of trunk and limb movement to prepare the trunk for perturbations (Urquhart, et al. 2004).
  - These responses occur either before or slightly after the muscles producing the movement – **pre-programmed** by the Central Nervous System (Urquhart, et al. 2004).




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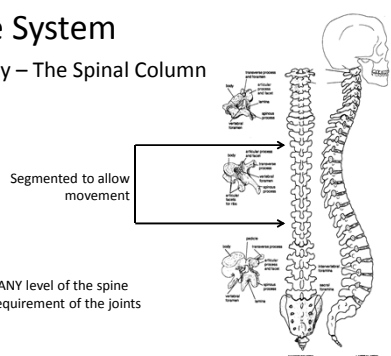
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## The Passive System

- Basic Anatomy – The Spinal Column




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## The Passive System

- Basic Anatomy – The Spinal Column

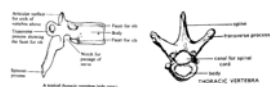
### The Cervical Vertebrae

- Moderate F/E
- Good Rot



### The Thoracic Vertebrae

- Limited F/E
- Limited Rot



### The Lumbar Vertebrae

- Good F/E
- Limited Rot




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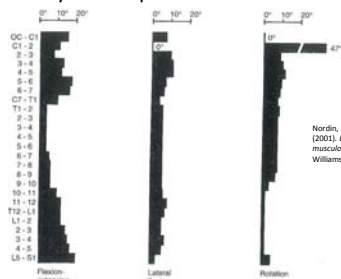
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## The Passive System

- Basic Anatomy – The Spinal Column

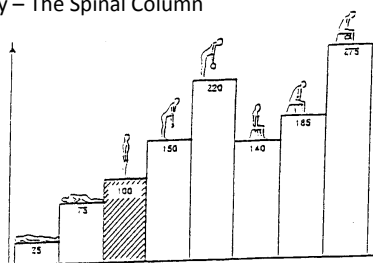


Nordin, M., & Frankel, V. H. (Eds.). (2001). *Basic biomechanics of the musculoskeletal system*. Lippincott Williams & Wilkins, Fig. 10-7

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## The Passive System

- Basic Anatomy – The Spinal Column



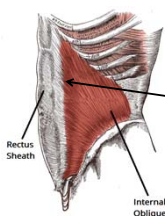
Nachemson, A. (1975). Towards a better understanding of back pain. A review of the mechanics of the lumbar disc. *Rheumatol Rehabil*, 14, 129.

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## The Active System

- Basic Anatomy – Rectus Abdominus (RA)

Upper 1/4 enclosed by a sheath formed from the aponeurosis of the Obliques and TA



- IO divides into 2
- Anterior sheath blends with EO to pass in front
- Posterior sheath with TA to pass behind
- All join again at the Linea Alba

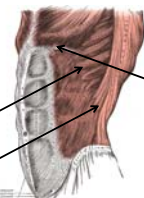
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## The Active System

### • Basic Anatomy – External Oblique (EO)

8 Fleishy digitations from the lower 8 ribs–

- 5 superior are received between corresponding Serratus Anterior and
- 3 lower from the lats dorsi



Internal surface connects with the IO



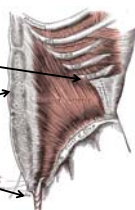
## The Active System

### • Basic Anatomy – Internal Oblique (IO)

Attachments into the LDF and iliac crest

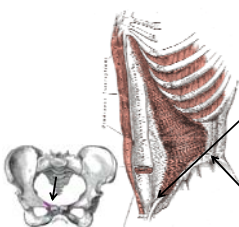
Attachments into the Linea Alba

Inserts conjointly with TrA into pubis and pectineal line



## The Active System

### • Basic Anatomy – Transverse Abdominals (TA)



- O – Crest of the ilium, lower six costals – Interdigitates with the diaphragm & through a broad aponeurosis to the Lx processes
- Fibres insert together in a conjoint tendon with the IO into the crest of the pubis and pectineal line (purple)

Vertabral aponeuroses of the TrA divides into three layers

- Between anterior and middle layer = QL
- Between Mid and Post – ES
- Posterior lamella of this aponeurosis also receives the IO attachment and Lat Dorsi forming the Lx Fascia

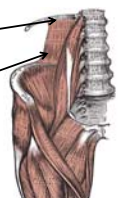


## The Active System

- Basic Anatomy – Quadratus Lumborum (QL)

Inserts onto 12<sup>th</sup> Costal and T<sub>12</sub> Processes of L<sub>1</sub> Vert.

QL is contained in a sheath formed by the anterior and middle lamellae of the aponeurosis of origin of TrA




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## The Active System

- Myofascial slings and force transfer



<http://www4.pictures.simbio.com/g/Tim+Cahill+MFC+Asian+Cup+Semifinal+Uzbekistan+38d9f8-huNEI.jpg>



Image from: <http://gravityworks.com/wp-content/uploads/2012/04/posterior-sagittal-chain-post-oblique.jpg>



<http://becua.com/talaysia-fortunato>




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## The Active System

- Myofascial slings and force transfer

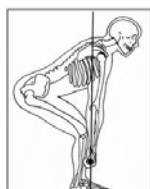
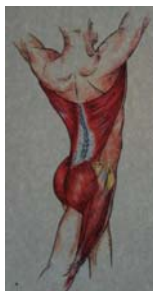


Image from: <http://gravityworks.com/wp-content/uploads/2012/04/posterior-sagittal-chain-post-oblique.jpg>




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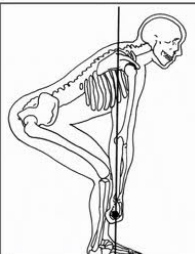
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## The Active System

- Myofascial slings and force transfer

<http://crossfitampify.com/wp-content/uploads/2014/08/military-deadlift-battle.jpg>



<http://redstickcrossfit.com/wp-content/uploads/2011/10/anne-digood3bad-430x204.jpg>



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## The Active System

- Abdominal Muscle Recruitment
  - ALL of the abdominal muscles have been reported to be active in advance of trunk and limb movement to prepare the trunk for perturbations (Urquhart, et al. 2004).

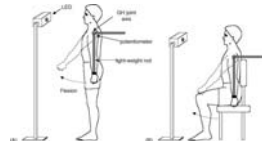
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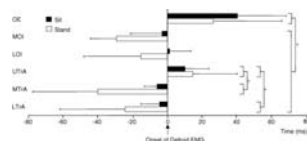
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## The Active System

### Abdominal Muscle Recruitment



Urquhart, D. M., Hodges, P. W., & Story, I. H. (2004). Postural activity of the abdominal muscles varies between regions of these muscles and between body position, Gait & Posture, 22(2005), 295-301.



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## The Active System

- Abdominal Muscle Recruitment
  - Postural activity (seated or standing) associated with limb movement (forward shoulder flexion) significantly different between regions of the TrA (Urquhart, et al. 2004).
  - Activity of one region of the TrA (Lower, Middle, Upper) does not reflect recruitment of the whole muscle (Urquhart, et al. 2004)
    - Lower and Middle TrA 24-40ms prior to Deltoid
    - Upper TrA up to 15ms after Deltoid AND 30-44ms after IO
    - All TrA preceded EO by 12-67ms
    - Upper TrA 5ms later in Standing compared to Sitting
    - Lower IO recruited a mean 15ms BEFORE in Standing and 1ms AFTER Deltoid in Sitting

MOST STUDIES ONLY LOOK AT A SPECIFIC REGION




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## The Active System

- Abdominal Muscle Recruitment
  - Pelvic motion decreases TrA activity (Urquhart, et al. 2006)
  - Pelvic tilting is likely to produce greater activity of Middle IO relative to TrA and RA (Urquhart, et al. 2006)
  - Abdominal bracing recruits EO with less activity of upper TrA, lower IO and RA (Urquhart, et al. 2006)




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## The Active System

- Abdominal Muscle Recruitment
  - For TrA alone – Discourage any movement of the upper abdominals, bracing of the abdominal walls or posterior tilting of the pelvis (Urquhart, et al. 2006)

<http://www4.pictures.rimbo.com/gg/Tim-Cahill-AFC-Asian-Cup-Semi-Final-Substitutions-38089-hzJNE1.jpg>




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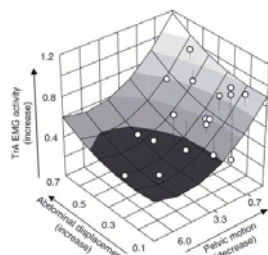
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## The Active System

Association between EMG activity, abdominal displacement and lumbopelvic motion. A three-dimensional graph depicting the relationship between EMG activity of all regions of TrA (as a proportion of the total abdominal muscle activity) (y axis), maximal abdominal displacement (x axis), and pelvic motion (z axis). EMG activity of TrA, relative to the other abdominal muscles, was greater when abdominal movement was performed without pelvic motion.

Urquhart, D. M., Hodges, P. W., Allen, T. J., & Story, I. H. (2005). Abdominal muscle recruitment during a range of voluntary exercises. *Manual therapy*, 10(2), 144-153. Fig 5



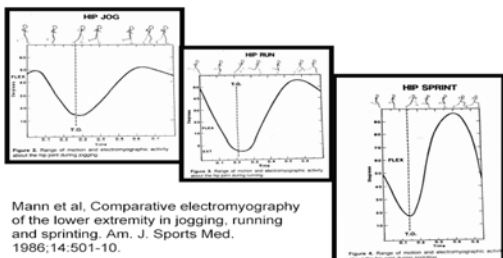
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## The Active System

- Does the pelvis move during gait?



Mann et al. Comparative electromyography of the lower extremity in jogging, running and sprinting. *Am. J. Sports Med.* 1986;14:501-10.

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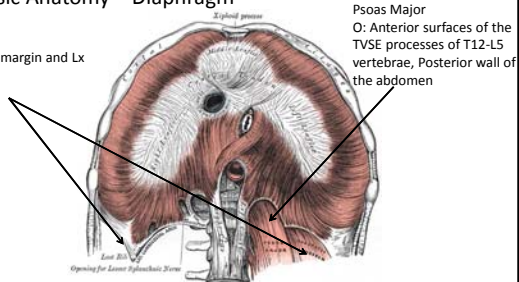
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## The Active System

- Basic Anatomy – Diaphragm

O: Costal margin and Lx Vert 1-3



Psoas Major

O: Anterior surfaces of the TVSE processes of T12-L5 vertebrae, Posterior wall of the abdomen

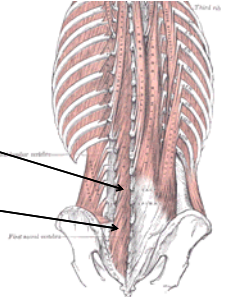
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## The Active System

- Basic Anatomy – The Multifidus



Transverse Process to Spinous process 1-4 higher

Sacrum and Aponeurosis of the ES

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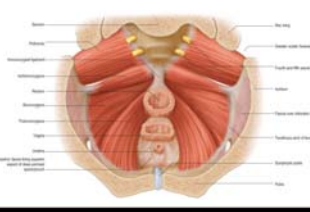
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## The Active System

- Basic Anatomy – The Pelvic Floor
  - Voluntary activity in the abdominal muscles lead to increased activity in the PFM (Sapford & Hodges, 2001).



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## What do you know about training the core?

- From what we have discussed would this:
  - Activate TrA/IO effectively?
  - What about the other 'core' muscles?



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## What do you know about trg the core?



<http://www.nhs.uk/Liverwell/fitness/PublishingImages/COMMON%20EXERCISE%20MISTAKES/plank.jpg>

<http://www.nhs.uk/Liverwell/fitness/PublishingImages/COMMON%20EXERCISE%20MISTAKES/stomach-crunch.jpg>

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## What do you know about trg the core?

- Remember: With decreased use or lack of use (pain inhibition, motor dysfunction or OG) tonic/ local muscles systems (all of them) take on phasic / global characteristics (Jull, et al., 1999)
- This is why TrA/IO drawing-in is done –
  - To reteach the motor control (Not to increase endurance or strength)
  - This is also why load should be below 30-40% MVC – to stimulate slow tonic loading
- Then the movement is integrated back into functional tasks

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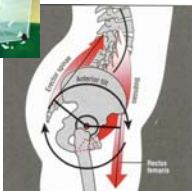
## What do you know about trg the core?

- So in INITIAL stages of rehabilitation following lower back pain / chronic back pain
  - \*Following assessment of need
- Teach correct muscle patterns
- Transfer into function
- Fix the cause of the dysfunction
  - \* Treat the criminal [cause], not just the victim [symptom]

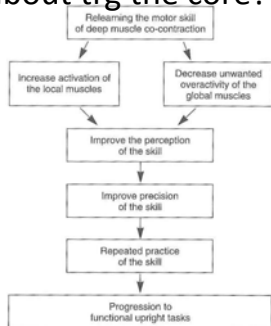
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## What do you know about trg the core?



Jull, G., Hodges, P., Hides, J., & Panjabi, M. M. (1999).  
Therapeutic exercise for spinal segmental stabilization in low  
back pain: scientific basis and clinical approach (pp. 61-76).  
Edinburgh: Churchill Livingstone., Fig 7.4



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## What do you know about trg the core?

- Choosing the right exercises for the initial phases...



[http://cdn2.b-examiner.com/sites/default/files/styles/image\\_core/rt\\_width/flash/g1/09/1332060555\\_PlanKArmLegIF500x240.jpg?hok=80v0R03](http://cdn2.b-examiner.com/sites/default/files/styles/image_core/rt_width/flash/g1/09/1332060555_PlanKArmLegIF500x240.jpg?hok=80v0R03)



<http://ourbodyhealth.net/wp-content/uploads/2013/01/Bulgarian-Split-Squat.jpg>

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## What do you know about trg the core?

- McGill vs Hodges
  - A: McGill
  - B: Hodges
  - C: All of the above
  - D: None of the Above
  - E: C&D

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## What do you know about trg the core?

Bjerkefors, et al., 2010

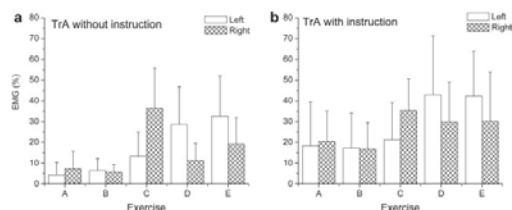
- Looked at 5 exercises comparing LvR and with/without Instruction



Bjerkefors, A., Ekblom, M. M., Josefsson, K., & Thorstensson, A. (2010). Deep and superficial abdominal muscle activation during trunk stabilization exercises with and without instruction to hollow. *Manual therapy*, 15(5), 502-507. Fig. 1.



## What do you know about trg the core?

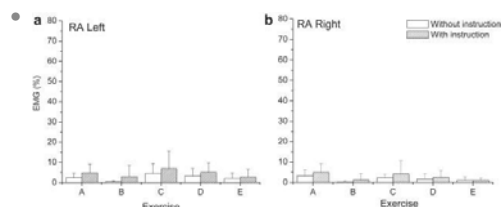


Mean values ( $\pm 1SD$ ) of relative EMG amplitudes (in % of the highest observed in the MVC-tasks) for TrA (a) without instruction and (b) with instruction, on the left side (open bars) and on the right side (hatched bars) during the five exercises (A-E) investigated. (A) Supine with right leg lift, (B) bridging, (C) bridging with right leg lift, (D) four-point kneeling with right leg lift, and (E) four-point kneeling with right leg lift and left arm lift.

Bjerkefors, A., Ekblom, M. M., Josefsson, K., & Thorstensson, A. (2010). Deep and superficial abdominal muscle activation during trunk stabilization exercises with and without instruction to hollow. *Manual therapy*, 15(5), 502-507. Fig. 4.



## What do you know about trg the core?



Mean values ( $\pm 1SD$ ) of relative EMG amplitudes (in % of the highest observed in the MVC-tasks) for Rectus Abdominis (RA) (a) on the left side and (b) on the right side, without instruction to hollow (open bars) and with instruction to hollow (hatched bars) during the five exercises (A-E) investigated. (A) Supine with right leg lift, (B) bridging, (C) bridging with right leg lift, (D) four-point kneeling with right leg lift, and (E) four-point kneeling with right leg lift and left arm lift.

Bjerkefors, A., Ekblom, M. M., Josefsson, K., & Thorstensson, A. (2010). Deep and superficial abdominal muscle activation during trunk stabilization exercises with and without instruction to hollow. *Manual therapy*, 15(5), 502-507. Fig. 3.



## What do you know about trg the core?

Urquhart, et al., 2006

- **Pelvic tilting** is likely to produce greater activity of Middle IO relative to TrA and RA
- **Abdominal bracing** recruits EO with less activity of upper TrA, lower IO and RA (Urquhart, et al. 2006)
- **For TrA alone – Discourage** any movement of the upper abdominals, bracing of the abdominal walls or posterior tilting of the pelvis (Urquhart, et al. 2006)




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## What do you know about trg the core?

Tehyen, et al. 2008

- Changes in TrA and IO muscle thickness differed during 6 trunk strengthening exercises as assessed with USI.
  - Abdo crunch; ADIM, Abdo Sit back, Side Plank, Supine lower extremity extender; Bird dog
- Specifically, the greatest changes in muscle thickness of both muscles were found with the horizontal side-support and the abdominal crunch.




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## What do you know about trg the core?

Himes, et al., 2012

- Further examined the Side Plank with Healthy and Non symptomatic sufferers from LBP (5 levels of difficulty)
- No differences between groups at any level
- Only difference within groups was the healthy DECREASED activation of the TrA at higher levels
- The recurrence of LBP may not be because of the ability of the TrA to contract but rather the timing of when the TrA becomes activated during exercise




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## What do you know about trg the core?

Koumantakis, et al., 2005

- General Exercise program or General Exercise Program with Isolation core exercises
- Outcome measures for both groups improved with generally no differences between the 2 exercise approaches.
- Self-reported disability improved more in the general exercise-only group immediately after intervention but not at the 3-month follow-up.




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## What do you know about trg the core?

Koumantakis, et al., 2005

- A general exercise program reduced disability in the short term to a greater extent than a stabilization-enhanced exercise approach in patients with recurrent nonspecific low back pain.
- Stabilization exercises do not appear to provide additional benefit to patients with subacute or chronic low back pain **who have no clinical signs suggesting the presence of spinal instability.**




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## What do you know about trg the core?

Monfort-Panego, et al., 2009

- When Sitting Up
  - Initial phase of the exercise during dorsolumbar spine flexion the RA is activated then decreases when Lx is around 30°-45° HF activation increases
  - Having the feet fixed during a sit up increases HF activity – having the arms fixed increases abdominal activity



1 Joint Public Affairs Unit - Actresses




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## What do you know about trg the core?

### Nesser, et al 2008

- Correlations between strength, power and core strength
  - Core strength measured using the protocol established by McGill (7) – Results correlated to power (e.g. Dash, power clean and CMJ) and strength (1RM Bench and Squat)
  - Results suggest weak to moderate correlations
  - Authors suggest that increases in core strength are not going to contribute significantly to strength and power and should not be the focus of strength and conditioning.




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## What do you know about trg the core?

### Scibek, 1999 : Stanton, et al, 2004

- Scibek, 1999
  - Swissball training 2 x 6/52
  - Sig improvement in core stability
  - No sig improvement in myoelectric activity of the abdominal and back muscles, treadmill VO2max, running economy, or running posture in either group
- Stanton, et al, 2004
  - Similar findings with Swissball




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## What do you know about trg the core?

### Saeterbakken et al, 2011

- Looked at core training to increase throwing velocity
  - Intervention group performed a progressive core stability-training program consisting of 6 unstable closed kinetic chain exercises in slings
  - Sig increase in throwing velocity
  - Authors state that their results suggest that core stability training using unstable, CKC movements can sig improve maximal throwing velocity.
  - A stronger and more stable lumbopelvic-hip complex may contribute to higher rotational velocity in multisegmental movements




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## What do you know about trg the core?

Leetun, et al. 2004

- Core stability as an injury risk predictor
  - 80 ♀ 60 ♂ Intercollegiate basketball and track and field athletes
  - Hip Abduction and ER sig predictors
  - Side plank and back extension were not predictors (Large SD)
  - Claim that core stability has an important role to play in injury prevention




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## What do you know about trg the core?

Rehab Considerations

- Contemporary approach for LBP involves recruitment of TrA with minimal activity of the superficial abdominal muscles in the EARLY stages of Rehab (Urquhart, et al. 2005).
- Abdominal hollowing isolates the co-activation of TrA and OI for patients with spinal instability – retrain perturbed motor patterns (Monfort-Panego et al, 2009).




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## What do you know about trg the core?

Rehab Considerations

- ALL trunk muscles play a role in spinal stability – 1-2 muscles should NOT be the specific targets when training the abdominal (Monfort-Panego et al, 2009)
- Retraining of 6-8 treatments with low level US guided abdominal drawing in OR sling exercises OR GENERAL Exercises for CLBP attained only marginal changes in contraction thickness and slide in deep abdominal muscles – only provide a limited account for pain reduction (Vasseljen & Fladmark, 2010).




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## So where does this leave the core?

- Would the 'core' protect them?



[http://37.media.tumblr.com/tumblr\\_mhy0dewi581nrfpbo1\\_500.jpg](http://37.media.tumblr.com/tumblr_mhy0dewi581nrfpbo1_500.jpg)

<http://coachrobrogers.com/wp-content/uploads/2011/01/bad-deadlift.jpg>




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## So where does this leave the core?

- Would the 'core' protect them?



<http://www2.hdnux.com/photos/16/50/14/3834677/628x471.jpg>



1 JPAU Archives




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## So where does this leave the core?



<http://i.vimg.com/v4/7Gulgg0U9f/maaxesdefault.jpg>



<http://captainquinsbootcamp.com/wp-content/uploads/2014/01/park-slope-personal-training.jpg>




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## So where does this leave the core?

- Rehab in isolation (as qualified) and then integrate early back into global movements (in the same posture)




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## So where does this leave the core?

- Get back to Task Specific Training or global tasks that generally mimic tactical tasks
  - If the 'core' is a concern then it is either
    - Mismatched with global force production
    - Mismatched with muscular endurance
    - = Progressed too fast – regress and retrain.



U.S. Army Public Affairs Unit - Fort Benning




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## So where does this leave the core?

- It is not the magical answer – it is just another message lost in a marketing scheme
- If there is a dysfunction seek retraining (isolate then integrate)
- Train movement and you will train the 'core'.




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